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SUGHRUE MION, PLLC 2100 PENNSYLVANIA AVENUE, N.W. SUITE 800 WASHINGTON, DC 20037				
EXAMINER				
MARTIN, MATTHEW T				
ART UNIT		PAPER NUMBER		
1795				
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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# Office Action Summary

**Application No.**

10/571,054

**Applicant(s)**

WATANABE ET AL.

**Examiner**

MATTHEW T. MARTIN

**Art Unit**

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,2 and 4-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2 and 4-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/CD)  
Paper No(s)/Mail Date 12/29/2009
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_

## **DETAILED ACTION**

### ***Status of Claims***

1. Claims 1, 2 and 4-23 are pending and are examined below.

### ***Claim Rejections - 35 USC § 103***

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 2 and 4-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mikoshiba et al., U.S. Patent No. 6,384,321 in view of MacFarlane, "Ionic liquids

based on imidazolium, ammonium, and pyrrolidinium salts of the dicyanamide ion", Green Chemistry, 2002.

Regarding Claim 1, Mikoshiba et al. teaches an electrolyte, specifically for use in a dye sensitized solar cell, comprising a halogen redox pair for improved carrier transport, and an ionic liquid.

Furthermore, Mikoshiba et al. teaches that the ionic liquid can include an electrolyte with an imidazolium salt (see column 2, lines 45-50) along with a quaternary ammonium salt. Finally, Mikoshiba et al. teaches that a gel electrolyte is preferable in solar cell applications.

Mikoshiba et al. does not teach specifically that dicyanamide can be used as the anion.

Macfarlane et al. teaches an ionic liquid including dicyanoamide anions as anions (see introduction at paragraph 2). An ionic liquid is an electrolyte, as an electrolyte is merely an electrically conductive composition with free ions. The dicyanoamide anions claimed by applicant are analogous to the dicyanamide anions taught by MacFarlane, because the molecular structure is identical (compare paragraph 45 with fig. 1 of MacFarlane). Furthermore, applicant refers to exemplary embodiments as both dicyanoamide (see paragraph 45) and dicyanamide (see claim 8). MacFarlane specifically teaches that the dicyanamide features strong ionic transportation properties (see introduction, fourth paragraph).

Therefore, it would be obvious to one of ordinary skill in the art to substitute the electrolyte taught by Mikoshiba et al. by using the dicyanamide anion taught by

MacFarlane because the dicyanamide anion features strong ionic transportation properties (see introduction, fourth paragraph).

Regarding Claim 2, MacFarlane et al. teaches an ionic liquid comprising cations with quaternized nitrogen atoms (see, e.g. fig. 1 and synthesis and characterization, paragraph 1).

Regarding Claim 4, Claim 4 is read by the examiner as an intended use claim. Therefore, because MacFarlane et al. teaches the electrolyte itself, MacFarlane anticipates Claim 4.

Regarding Claim 7, MacFarlane et al. teaches an electrolyte composition featuring a dicyanamide anion with a quaternized nitrogen atom.

Regarding Claims 8 and 9, MacFarlane et al. teaches that the ionic liquid may include 1-ethyl-3-methylimidazolium (see table 1 and page 446, paragraph 6).

Regarding Claim 16, MacFarlane et al. teaches using water as an additive (see general synthesis, paragraph 2).

Regarding Claim 6, Mikoshiba et al. teaches a dye sensitized solar cell (see column 2, lines 50-68).

Regarding Claims 10-12, Mikoshiba et al. teaches a halogen based redox pair including a I- and I3-, taught by applicant in claims 11 and 12 to be the halide and polyhalide used in the present invention (see column 5, lines 25-35).

Regarding Claim 13 and 14, Mikoshiba et al. teaches a halogen redox pair obtained by mixing iodine and iodide ions which includes mixing halide ions with halogen molecules (see column 5, lines 25-35).

Regarding Claim 15, Mikoshiba et al. teaches the addition of a gelator (see column 12, line 65 through column 13, line 5).

Regarding Claim 17, Mikoshiba et al. teaches a dye sensitized solar cell comprising a transparent electrode substrate (2), a working electrode having oxide semiconductor particles formed on the transparent electrode substrate (4) with a photosensitized dye absorbed thereon, a counter electrode opposed to the working electrode (5), and an electrolyte layer (10) in between (see fig. 1 and column 18, lines 30-35, 40-50 and 60-68).

Regarding Claim 18, Mikoshiba et al. teaches a transparent conducting oxide deposited on a transparent substrate (see column 18, lines 30-35).

Regarding Claim 19, Mikoshiba et al. teaches a glass substrate (see column 19, lines 20-25).

Regarding Claim 20, Mikoshiba et al. teaches a transparent conductive layer comprising tin oxide (see column 14, line 65 through column 15, line 5).

6. Claims 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mikoshiba et al. in view of MacFarlane et al. as applied to Claims 1, 2 and 5-20 above, and further in view of Koyanagi et al., U.S. Publication No. 2003/0150485.

Regarding Claim 21, MacFarlane et al. in view of Mikoshiba et al. teaches a dye sensitized solar cell as discussed above.

Neither reference teaches the TCO layer with a thickness between .05 micrometers and 2 micrometers, as Mikoshiba et al. is silent on the thickness of the TCO layer, merely stating that the layer must maintain transparency.

Koyanagi et al. teaches a .5 micrometer thick TCO layer deposited upon a glass substrate (see paragraph 223).

Therefore, it would be obvious to one of ordinary skill in the art to modify the thickness of the transparent conductive oxide layer taught by Mikoshiba et al. by using a .5 micrometer thick layer as taught by Koyanagi et al. to maintain transparency of the surface, allowing the active area to be exposed to a sufficient amount of light (see paragraph 69).

Regarding Claim 22, Mikoshiba et al. teaches a dye sensitized solar cell as discussed above. Additionally, Mikoshiba et al. teaches that titanium oxide semiconductor particles are used.

Mikoshiba et al. does not specifically teach that the metal oxide semiconductor layer having a thickness between .5 and 50 micrometers, nor does Mikoshiba et al. teach that the metal oxide semiconductor layer has a particle diameter between 1 and 1000 nm because Mikoshiba et al. is silent on thickness and particle size.

Koyanagi et al. teaches a titanium dioxide metal oxide semiconductor layer (see paragraph 16) with particles having a crystalline diameter ranging from 5 to 50 nm (see paragraph 17). Additionally, Koyanagi et al. teaches that the thickness of the metal oxide semiconductor film should be between .1 and 50 micrometers (see paragraph 17).

Therefore, it would be obvious to one of ordinary skill in the art to modify the metal oxide semiconductor film thickness and the particle diameter taught in the dye sensitized cell taught by Mikoshiba et al. by using the values taught by Koyangi et al. because the Koyangi et al. design increases the efficiency of the device by allowing

electrons to move rapidly through the high surface area of the metal oxide film (see paragraphs 6 and 8).

Regarding Claim 23, Koyanagi et al. is silent on the photoelectric conversion efficiency, although Koyanagi et al. teaches that the advantages of the device taught include improved efficiency.

However, because all positively recited structural limitations are taught between the combination of MacFarlane with Mikoshiba et al. and Koyanagi et al., it is the examiner's position that the claim 23 efficiency limitation is met, or, alternatively, would be an obvious optimization for one of ordinary skill in the art.

Furthermore, Mikoshiba et al. teaches that electrolyte composition has an effect on energy conversion efficiency (see column 2, lines 35-40). Therefore, Mikoshiba et al. identifies conversion efficiency as a known results effective variable. The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05). Therefore, it would be obvious to one of ordinary skill in the art to maximize conversion efficiency using the parameters of electrolyte composition, along with the selection of materials, because conversion efficiency directly correlates with performance (see column 2, lines 35-40).

### ***Response to Arguments***

7. Applicant's arguments with respect to the 103 rejection of Claim 3, incorporated into the present Claim 1, have been considered and are persuasive. While a halogen



containing pair is included in the production of the dicyanamide compound, applicant is correct in that the iodine is removed from the final synthesized product.

However, although applicant is correct with respect to this argument, applicant's arguments regarding the 103 rejections are unpersuasive.

Applicant correctly notes that halogen additions can increase the viscosity of the electrolyte. However, because Mikoshiba et al. teaches the utility and desirability of a gel electrolyte, this argument is unpersuasive. One of ordinary skill would know use the dicyanamide compound taught by MacFarlane independent of viscosity due to the strong transport properties of dicyanamide.

Furthermore, applicant does not produce any unexpected results as to the incorporation of a halogen redox pair with the dicyanamide. Applicant merely discloses in the background, consistent with the state of the art in dye sensitized devices, that a halogen redox pair is used.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW T. MARTIN whose telephone number is (571)270-7871. The examiner can normally be reached on 8:30 to 5:00 EST Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Michener can be reached on (571)272-1424. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MATTHEW T MARTIN/  
Examiner, Art Unit 1795  
3 March 2010

/Jennifer K. Michener/  
Supervisory Patent Examiner, Art Unit 1795